

From the INTERNATIONAL BUREAU

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner  
US Department of Commerce  
United States Patent and Trademark  
Office, PCT  
2011 South Clark Place Room  
CP2/5C24  
Arlington, VA 22202  
ETATS-UNIS D'AMERIQUE  
in its capacity as elected Office

<b>Date of mailing (day/month/year)</b> 11 June 2001 (11.06.01)	<b>Applicant's or agent's file reference</b> NJE/G13772WO
<b>International application No.</b> PCT/GB00/03534	<b>Priority date (day/month/year)</b> 16 September 1999 (16.09.99)
<b>International filing date (day/month/year)</b> 14 September 2000 (14.09.00)	
<b>Applicant</b> BEARD, Paul et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
06 April 2001 (06.04.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<b>The International Bureau of WIPO</b> 34, chemin des Colombettes 1211 Geneva 20, Switzerland	<b>Authorized officer</b> Olivia TEFY
<b>Facsimile No.:</b> (41-22) 740.14.35	<b>Telephone No.:</b> (41-22) 338.83.38

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference NJE/G13772WO	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/03534	International filing date (day/month/year) 14/09/2000	Priority date (day/month/year) 16/09/1999
International Patent Classification (IPC) or national classification and IPC G01N29/24		
Applicant UNIVERSITY COLLEGE LONDON et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  06/04/2001	Date of completion of this report  07.01.2002
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Mason, W  Telephone No. +49 89 2399 2623 

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/03534

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-12 as originally filed

**Claims, No.:**

1-19 as originally filed

**Drawings, sheets:**

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/03534

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

## V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

### 1. Statement

Novelty (N)	Yes:	Claims
	No:	Claims 16, 18
Inventive step (IS)	Yes:	Claims
	No:	Claims 1-14, 17, 19
Industrial applicability (IA)	Yes:	Claims 1-19
	No:	Claims

2. Citations and explanations  
**see separate sheet**

**RE SECTION V**

1. The following documents are referred to in this report:

D1=Applied Optics Vol. 35; Nr. 4; pages 663-675; 01 February 1996; Beard P C and T N Mills; "Extrinsic optical-fiber ultrasound sensor using a thin polymer film as a low-finesse Fabry-Perot interferometer".

D2=Electronics Letters Vol. 33; Nr. 9; pages 801-803; 24 April 1997; Beard P C and T N Mills; "Miniature optical fibre ultrasonic hydrophone using a Fabry-Perot polymer film interferometer".

D3=Ultrasonics Vol. 37; Nr. 1; pages 45-49, January 1999; Wilkens V and Koch Ch; "Fiber-optic multi layer hydrophone for ultrasonic measurement".

D4=Optics letters vol 24, no 15, pages 1026-1028; 01 August 1999; Wilkens V and Koch Ch; "Optical multi layer detection array for fast ultrasonic field mapping".

D6=US4360820

2. The present application relates to an optical sensor (in particular but not limited to examination of e.g. medical tissue) using an optical interrogation signal directed normally and extending over a thin film disposed over a substrate in the sensor head. Variations in the positions of the thin film surfaces acting as the mirrors of an interferometer cavity are detected by the interrogation signal. In the main embodiment of the mode of operation, optical pulses generate acoustic waves in the subject to be examined (e.g. medical tissue) which are representative of the composition of the subject (tissue).

3. PRIOR ART

D1 (Figs. 1, 5; pages 64, 669-670) discloses the use of polymers on fiber tips for opto-acoustic sensing using laser pulse excitation to generate thermo-elastic waves.

D2 (Fig. 1) discloses the use of a polymer film on a fibre tip for ultrasound detection.

D3 (Fig. 1) discloses the use of evaporated dielectric coatings on fiber tips for ultrasonic measurement as an improvement on polymer film tipped fibres.

D4 (Fig. 4) discloses a detection array for ultrasonic mapping using a glass plate coated with a dielectric multi layer system in which the whole detection array is illuminated with an interrogating collimated laser beam for parallel evaluation over the whole of the sensor head using e.g. a two dimensional CCD array.

D4 reference 2 is to D3, D3 reference 2 is to D2, D2 reference 5 is to D1 so that the skilled person reading D4 would be aware of the content of D1-D3.

#### 4. CLAIMS 1-15

##### 4.1 NOVELTY (Art. 33.2 PCT)

D4 summarised above is considered to represent the closest prior art - this document discloses all features of the sensor of claim 1 except:

a) the use of a polymer film (as the interferometric enhancing structure).

Claim 1 and dependent claims 2-15 therefore meet the requirement of novelty.

##### 4.2 INVENTIVE STEP (Art. 33. PCT)

Re a):

D1-D4 are numbered according to publication date - the overall teaching of this prior art vis a vis optical detection of ultrasonic signals is that initially fibre optic sensors using a thin polymer film as a low finesse Fabry Perot interferometer were developed (D1-D2). Subsequently the possibility of replacing the polymer on the fiber tip with a dielectric multi layer structure (D3, col 1) was suggested, and later

the "enlargement of the acoustic probe" by replacing the fiber arrangement with a glass plate (D4) was proposed.

The skilled person reading D4 would therefore clearly be aware of D3, and in particular the passage on page 45, col 1 headed "Introduction" which concisely summarises technology with which such persons are familiar. This passage clearly presents the use of polymer films and evaporated dielectric coatings as well-known alternative interferometric enhancing structures whose modus operandi is a deformation under the action of acoustic pressure waves leading to modification of the optical interference patterns. In the selection of either of these materials, the application (single point or two dimensional) is of no consequence - in particular the "enlarged" two dimensional form of the sensor head in D4 does not restrict the form of the interferometer layer to dielectric coatings only.

In addition, the advantages of using multilayer dielectrics listed in D3 are both relative ("simple" manufacturing - spinning a polymer film is considerably less time consuming than using vacuum evaporation equipment), non-exclusive (pages 3-4 of the application lists advantages of using polymer films) and do not represent a prejudice towards skilled persons considering the use of polymers.

The skilled person reading D4 would therefore be familiar with using polymer films in place of dielectric films in these devices as the most obvious alternative interferometric enhancing structure. The selection according to feature a) would therefore not require any inventive activity on behalf of the skilled person.

Claim 1 therefore does not meet the requirement of inventive step.

Dependent claims 2-15 also do not meet the requirement of inventive step for the reasons indicated below:

Claims 2-3, 11-12. D4

Claims 4-6, 8-10. D1

Claim 7. D2 (Fig. 1).

Claim 13. Surface temperature measurement. D1 refers to the opto-acoustic excitation in terms of laser pulse generation of thermo elastic waves which indicates the dependence of the measurement on temperature and the requirement to monitor this parameter.

Claim 14. Optical arrangement for altering the angle of incidence of the interrogation signals. D4 (Fig. 4) illustrates the use of a beam splitter BS for redirecting the interrogating laser beam to the sensor head. The requirement of normal incidence of the beam would most easily be implemented by rotating the BS.

Dependent claims 2-15 also do not meet the requirement of inventive step (Art. 33.3 PCT).

Claim 15. Neither D4 nor any of the remaining cited documents suggest selection of different angles of incidence for different location of the sensor head - the wording of claim 15 should be modified to comprise this feature as a apparatus component rather than a method step.

5. CLAIMS 16-19

The reference to the interferometer in these method claims is not considered to limit the subject-matter of the method any further than the steps following the wording "comprising" since the steps in manufacturing are not specified by reference to the finished product.

D6 (Fig.2; cols 5-6) is an example of the known techniques for forming polymer films on transparent substrates by e.g. spin coating and thermal evaporation of e.g. parlyene and curing by ultraviolet light. D6 does not specifically disclose curing of thermally evaporated films or electrons beam curing but these are well-known in the art.

In view of D6 claims 16, 18 do not meet the requirement of novelty (Art. 33.2 PCT) and claims 17, 19 do not meet the requirement of inventive step (Art. 33.3 PCT).



# PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

**The International Bureau of WIPO**  
34, chemin des Colombettes  
CH - 1211 Geneva 20  
Switzerland

REC'D 09 JAN 2002

PCT  
WIPO PCT

NOTIFICATION CONCERNING  
DOCUMENTS TRANSMITTED

Date of mailing  
(day/month/year)

07.01.2002

International application No: PCT/GB00/03534

This International Preliminary Examining Authority transmits herewith the following documents:

1. ☐ demand (Rule 61.1(a)).
2. ☒ copy of the international preliminary examination report and its annexes (Rule 71.1).
3. ☐ \_\_\_\_\_ other documents (*specify*):

Name und mailing address of the IPEA/

 European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized officer

Weber, R

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1932

PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>NJE/G13772W0</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 00/ 03534</b>	International filing date (day/month/year) <b>14/09/2000</b>	(Earliest) Priority Date (day/month/year) <b>16/09/1999</b>
Applicant  <b>UNIVERSITY COLLEGE LONDON</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

**1. Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1  
☐ None of the figures.

## INTERNATIONAL SEARCH REPORT

International Application No

PC 00/03534

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 G01N29/24 G01H9/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, COMPENDEX

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>BEARD P C ET AL: "EXTRINSIC OPTICAL-FIBER            ULTRASOUND SENSOR USING A THIN POLYMER            FILMS A LOW-FINESSE FABRY-PEROT            INTERFEROMETER"            APPLIED OPTICS,US,OPTICAL SOCIETY OF            AMERICA,WASHINGTON,            vol. 35, no. 4,            1 February 1996 (1996-02-01), pages            663-675, XP000630302            ISSN: 0003-6935            page 664; figures 1,5            page 669 -page 670</p> <p style="text-align: center;">--- -/--</p>	1-15



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*&\* document member of the same patent family

Date of the actual completion of the international search

12 January 2001

Date of mailing of the international search report

27/02/2001

Name and mailing address of the ISA

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 NL - 2280 HV Rijswijk  
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Authorized officer

Mason, W

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/03534

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BEARD P C ET AL: "MINIATURE OPTICAL FIBRE ULTRASONIC HYDROPHONE USING A FABRY-PEROT POLYMER FILM INTERFEROMETER" ELECTRONICS LETTERS,GB,IEE STEVENAGE, vol. 33, no. 9, 24 April 1997 (1997-04-24), pages 801-803, XP000695342 ISSN: 0013-5194 figure 1	1-15
A	WILKENS V ET AL: "Fiber-optic multilayer hydrophone for ultrasonic measurement" ULTRASONICS,GB,IPC SCIENCE AND TECHNOLOGY PRESS LTD. GUILDFORD, vol. 37, no. 1, 1999, pages 45-49, XP004154492 ISSN: 0041-624X figure 1	1-15
X	V. WILKENS AND CH. KOCH: OPTICS LETTERS, vol. 24, no. 15, 1 August 1999 (1999-08-01), pages 1026-1028, XP000973108 figure 4	1-15
A	HODNETT M ET AL: "A strategy for the development and standardisation of measurement methods for high power/cavitating ultrasonic fields: review of high power field measurement techniques" ULTRASONICS: SONOCHEMISTRY,GB,BUTTERWORTH-HEINEMANN, vol. 4, no. 4, 1 October 1997 (1997-10-01), pages 273-288, XP004101694 ISSN: 1350-4177 page 280 -page 281	1-15
X	US 4 360 820 A (FORSTER ALETTE J ET AL) 23 November 1982 (1982-11-23) column 5 -column 6; figure 2	16-19
A	WO 97 27466 A (UNIV BROWN RES FOUND) 31 July 1997 (1997-07-31) page 17; claim 1; figures 6,10,16 page 85 -page 89	1-15
A	WO 96 23197 A (MASSACHUSETTS INST TECHNOLOGY) 1 August 1996 (1996-08-01) page 1-2; claim 1; figure 1 page 9-10 page 24-28	1-15
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# INTERNATIONAL SEARCH REPORT

International Application No

PO B 00/03534

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>WO 93 01476 A (MASSACHUSETTS INST TECHNOLOGY) 21 January 1993 (1993-01-21) page 12 -page 17; claim 1; figures 2,3 -----</p>	1-15

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 00/03534

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4360820	A	23-11-1982	CA 1145465 A	26-04-1983
			DE 3036902 A	02-04-1981
			DE 3036903 A	02-04-1981
			FR 2466829 A	10-04-1981
			GB 2060191 A, B	29-04-1981
			JP 56051386 A	08-05-1981
			NL 8005423 A	03-04-1981
WO 9727466	A	31-07-1997	US 5748318 A	05-05-1998
			DE 19681741 T	17-12-1998
			US 5959735 A	28-09-1999
WO 9623197	A	01-08-1996	EP 0805947 A	12-11-1997
			IL 116789 A	11-04-1999
			JP 10512958 T	08-12-1998
			US 5734470 A	31-03-1998
WO 9301476	A	21-01-1993	EP 0593667 A	27-04-1994
			US 5633711 A	27-05-1997